

REMARKS

At page 2, lines 1-3 of the Office Action, the Examiner requested that the specification include a reference that both reissue applications, Serial No. 09/502,120 and 09/502,534, which are each a reissue of U.S. Application No. 08/606,854 filed February 26, 1996, now U.S. Patent No. 5,717,204. Applicants have herein amended the specification according to the Examiner's request.

At page 2, item 1 of the Office Action, the Examiner noted that the reissue application was lacking written consent of all assignees owning an undivided interest in the patent. Applicants hereby submit written consent of KLA-Tencor, the sole assignee of U.S. Patent No. 5,717,204 (hereinafter the '204 patent), as signed by a party authorized to act on behalf of the assignee.

At page 2, item 2 of the Office Action, the Examiner stated that reissue oath/declaration filed with the application was defective because it failed to identify at least one error which is relied upon to support the reissue application. Applicants respectfully disagree. It is has been clearly recognized within patent law and patent prosecution procedure that an attorney's failure to appreciate the full scope of the invention is an error correctable through the reissue process. *See MPEP §1402; In re Wilder, 736 F.2d 1516, 222 USPQ 369 (Fed. Cir. 1984).* Accordingly, the oath/declaration filed by Applicants stated as its error:

My intent to claim all disclosed embodiments of the invention was not carried out through the course of prosecution of unnecessarily restricted claims by my former attorney of record.

Reissue Application Declaration by the Inventors, as submitted on October 2, 2000 as part of the *Response to Notice to File Missing Parts of Reissue Application*. Because this error is a proper

basis for reissue, Applicants respectfully submit that they have identified at least one error which is relied upon to support the reissue application.

At page 2, item 3 of the Office Action, the Examiner stated that the reissue oath/declaration is defective because it fails to contain a statement that the inventors are “the original, first and joint” inventors as required by 37 CFR 1.63(a)(4). Applicants respectfully disagree. Each Applicant’s declaration included the following statement (as found on Form PTO/SB/51, page 1):

I believe I am the original, first and sole inventor (if only one name is listed below) or *an original, first and joint inventor* (if plural names are listed below) of the subject matter which is described and claimed in patent number 5,717,204, granted February 10, 1998...

Reissue Application Declaration by the Inventors (emphasis added), mailed October 2, 2000, as part of the *Response to Notice to File Missing Parts of Reissue Application*.

The Examiner also stated that the reissue oath/declaration is defective because it fails to contain a statement that all errors which are being corrected in the reissue application up to the time of filing of the oath/declaration arose without any deceptive intention on the part of the application. Applicants respectfully disagree. In Applicants’ *Response to Notice to File Missing Parts of Reissue Application*, mailed October 2, 2002, each Applicant’s declaration included the following statement (as found on Form PTO/SB/51, page 2):

All errors corrected in this reissue application arose without any deceptive intention on the part of the applicant.

Reissue Application Declaration by the Inventors, mailed October 2, 2000, as part of the *Response to Notice to File Missing Parts of Reissue Application*.

At page 2, item 4 of the Office Action, the Examiner stated that Claims 1-61 are rejected based upon a defective reissue declaration, as set forth in the preceding items 1-3. In light of the Applicants' response that addresses all aspects of the defective reissue declaration, Applicants hereby respectfully submit that this rejection of Claims 1-61 should be withdrawn.

Objected Informalities

At page 3, item 5 of the Office Action, the Examiner objected to claims 31, 37, 40, 42, 55, and 56 because "a electron" should be "an electron." The Examiner objected to claims 57 and 58 because "column" should be "claim." Applicants herein cancel claims 31, 57, and 58, and amend the remaining claims according to the Examiner's suggestions.

Explanation of Amendments

As indicated above, the specification was amended in two places. First, a paragraph was added to include the reference to the co-pending reissue application, Serial No. 09/502,120. Second, the specification was amended at col. 11, line 21 to correct a typographical error in which "mA" was inadvertently written as "Ma."

Claim 27 is amended herein to change its dependency from claim 9 to being dependent from claim 26. Because this amendment is one of form, Applicants respectfully submit that the requirement to provide explanation of the support in the disclosure of the patent for this amendment, as specified in 37 CFR 173(c), is inapplicable.

Claim 28 is amended herein to change its dependency from claim 9 to being dependent from claim 27. Because this amendment is one of form, Applicants respectfully submit that the requirement to provide explanation of the support in the disclosure of the patent for this amendment, as specified in 37 CFR 173(c), is inapplicable.

Claim 30 is amended herein to provide proper antecedent basis. The phrase “particle beam column” was replaced by “first group of electrons,” and the phrase “generated by a particle beam column which” was added following “a charged particle beam.” Support for these changes can be found in Figures 4 and 5, and the accompanying textual descriptions of these Figures (see col. 8, line 25 – col. 14, line 14.).

As mentioned above in section entitled “Objected Informalities,” claims 37, 40, 42, and 55 are herein amended to correct the minor grammatical error in each of the claims, wherein the phrase “a electron source” is replaced with the grammatically proper phrase “an electron source.” Because these amendments are made to correct a grammatical error in each of the claims, Applicants respectfully submit that the requirement to provide explanation of the support in the disclosure of the patent for the amendments, as specified in 37 CFR 173(c), is inapplicable.

New claim 62 is added herein. Support for this claim can be found in the specification at col. 4, lines 1-11, which sets forth that there are two operational modes for the system.

Support for all other claim amendments, as required by 37 CFR 173(c), is provided below.

Rejections Under 35 U.S.C. § 112 ¶1

At page 3, item 6 of the Office Action, the Examiner rejected claims 20, 37-39, 48-55 and 59-61 under 35 U.S.C. § 112 ¶1, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art the inventors, at the time the application was filed, had possession of the claimed inventions.

Applicants respectfully disagree.

Concerning claim 20, the Examiner states that he does not “understand what is the potential maintained the equilibrium condition [sic]?” Claim 20 recites that the substrate is

maintained at a charge equilibrium condition by the combination of a first group of electrons and a second group of electrons, wherein surface charging creates a potential which maintains said equilibrium condition. Support for this claim can be found in the specification. For example, col. 12, line 60 through col. 13, line 6 states:

If the number of escaping secondary and backscattered electrons is greater than the number of primary beam electrons, surface 57 will charge positively which will increase the size of the retarding potential barrier created by electrode 107. Fewer low energy secondary electrons will now escape. The surface potential will move positively until balance is reached. If the number of escaping secondary and backscattered electrons is less than the number of primary electrons, the surface will charge negatively, which will lower the retarding potential barrier created by electrode 107. A larger number of low energy secondary electrons will now escape. The surface potential will move negatively until balance is reached. Under these conditions, a stable surface potential will emerge after some period of time.

As indicated in the above excerpt, the primary beam in combination with electrode 107 creates the electromagnetic potential that maintains equilibrium. Applicants respectfully submit that the invention is described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the invention claimed in claim 20.

Concerning claim 37, the Examiner states that he does not understand "How is the electron beam with an irradiance of greater than 1 milli-amp per steridian?" Claim 37 recites a system to automatically inspect a substrate. The system comprises an electron source to provide an electron beam from a high brilliance source with an irradiance of greater than 1 milli-amp per steradian, a charged particle beam column to deliver and scan the electron beam, an electron detector to detect electrons from the substrate as the electron beam scans the substrate, and a processor to examine an image from the detected electrons to determine features of the substrate.

Support for this claim can be found in the specification. For example, col. 8, lines 25-56 describe the scanning optics and the high beam current needed for the present invention to achieve higher imaging speed. The specification at column 8, line 57 – column 14, line 14 describe the electron optics, including the electron beam, the system to produce the electron beam, and the factors that determine the irradiance of the beam. For example, the specification states at column 11, lines 19-37 states:

The diameter of the scanning beam 100 and its current are determined by several factors. The angular emission from the source (1.0 mA/steradians), and the aperture angle defined by final aperture 99 determine the beam current. The probe diameter is determined by aberrations in both lenses, which are designed for high excitation (field width/focal length) to minimize both spherical and chromatic aberration. The effect of beam interactions (i.e. statistical blurring due to repulsion between individual beam electrons) are also important in this high current system, accounting for about half the probe size on substrate 57. These effects are minimized by avoiding intermediate crossovers, by using a short beam path (40 cm.) and by using lenses with relatively large half angles at the source and substrate 57. To obtain a given spot size, the aperture diameter is chosen to balance all these effects while providing maximum possible current. In this system spot size is primarily adjusted using the aperture, although it is possible to change lens strengths to magnify or demagnify the beam from the source.

The above excerpt, as well as the portions of the specification cited above, describes how the electron beam is generated and how to obtain the desired irradiance of the beam. Applicants respectfully submit that the invention is described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the invention claimed in claim 37.

Concerning claim 48, the Examiner states that he did not understand “How and/or what are the differences measured in alignment between the image and the information from the database?” Claim 48 recites that the system to automatically inspect a substrate also includes an

alignment processor to measure differences in alignment between a digitized version of an image from the detected electrons and the information from the database and then to use the alignment measurement to align the image and the information from the database. The specification states that the alignment computer 21 performs the alignment by accepting two digitized images (one image of the scanned image and one from a database) in gray scale values, and determining, in terms of fractional pixel distances, the misalignment between these images. The calculated alignment correction is used by the computer to shift the images into alignment so that the images are correctly aligned when analyzed by the defect processor. *See* col. 16, lines 24-50. Additional alignment calculations were incorporated by reference from U.S. Pat. No. 4,805,123 (Specht et al; "Automatic Photomask and Reticle Inspection Method and Apparatus Including Improved Defect Detector and Alignment Sub-System", issued Feb. 14, 1989 and assigned to the same assignee as the present application). *See* col. 16, lines 29-34. Applicants respectfully submit that the alignment structures and methods are described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the invention claimed in claim 48.

Concerning claim 49 and 59, the Examiner likewise rejected these claims under 35 U.S.C. §112 ¶1. Although claims 49 and 59 are directed to different inventions, both method claims involved the steps of (a) performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to control the charge density; (b) performing repeated swaths for a pattern feature of the substrate so as that the resulting multiple feature images are exactly aligned and can be overlaid precisely; and (c) averaging the multiple image features to maximize signal contrast in the image of the pattern feature. The Examiner's concern focused on how the multiple feature images are aligned and overlaid (step

(b)), and how the multiple image features are averaged to maximize signal contrast in the image of the pattern feature. See *Office Action*, p. 4, lines 11-13. The multiple feature images are aligned and overlaid by retracing the substrate with multiple scans. The specification at, for example, col. 6, line 32 – col. 7, line 67 and Figures 3a-3d describes different embodiments for performing multiple scans of the substrate. An embodiment disclosed in the specification involved scanning the substrate four times, but as noted in the specification, other numbers of multiple scans can also be performed. In response to the Examiner's second question regarding how the multiple feature images are averaged, this information is disclosed in the specification at column 17, lines 26-37, and Figure 11. The acquisition pre-processor module accepts an output from a detector and digitizes that output to an accuracy of 8 bits and then places it into multiple scan integrator 11. The multiple scan integrator averages the gray scale values from the same pixel. The averaged value is then transferred to shift register 13, which accepts eight bytes in series before transferring them in parallel to memory block 52. *See Col. 17, lines 26-37.* Applicants respectfully submit that the methods as claimed in claim 49 and 59 are described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed method.

Concerning claims 51 and 52, the Examiner states that he did not understand “[h]ow are the averaging the multiple image features to maximize signal contrast in the image of the pattern feature?” Applicants assert that the specification as originally filed adequately discloses how multiple scans are averaged to maximize the image is disclosed in the specification. For example, col. 6, line 32–col. 8, line 24, in conjunction with Figures 3b-3d, discusses embodiments of the multiple scan integration technique. Simply put, the signal-to-noise ratio is improved by averaging, for each pixel, the signal values from a number of scans of the same

position on the substrate. Applicants respectfully submit that the methods of claims 51 and 52 are described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Concerning claim 55, the Examiner states that he does not understand "how is the single electron source that provides both high and low energy electron beams at the same time? Claim 55, as amended herein, recites a system for automatically classifying defects in a substrate. The system includes a subsystem to provide a high energy electron beam and a low energy electron beam. For example, subsystem provides both the incident energy beam, which constitutes a high energy beam, and the returned electrons, which constitute the low energy beams. See, e.g., Figure 4 and col. 12, lines 16-19. Because the specification clearly discloses a system capable of producing both a high and a low energy electron beam incident upon the substrate, Applicants respectfully submit that the system of claim 55 is described in the specification so as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Rejection Under 35 U.S.C. § 112 ¶2

At page 4, item 7 of the Office Action, the Examiner rejected claim 30 as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Particularly, claim 30 lacked antecedent basis for "the particle beam column." Applicants herein amend claim 30 to remove the lack of antecedent basis and respectfully request withdrawal of this rejection.

Rejections Under 35 U.S.C. § 102(b)

At page 5, item 8 of the Office Action, the Examiner rejected claims 9-15, 17-22, 26-28 and 30 as being anticipated by U.S. Patent No. 4,453,086, issued to Grobman (hereinafter,

Grobman). Applicants respectfully submit that the Examiner did not disclose how Grobman anticipates any of the above listed claims. Thus, Applicants request further clarification from the Examiner as to how Grobman anticipates the listed claims. Furthermore, Applicants find the Grobman reference curious since it teaches contrary to the Applicants' understanding of physics. Grobman states that a "low energy beam would cause counteracting positive charging due to excessive emission of secondary electrons." *Grobman*, col. 2, lines 34-36. It is the Applicants understanding that a high energy beam, as apposed to a low energy beam, will generate positive charging by the production of secondary electrons. Low energy electron beams will tend to produce negative charging. Applicants respectfully request withdrawal of these rejections.

At page 5-6, item 8 of the Office Action, the Examiner rejected claims 9-22 and 26-30 as being anticipated by U.S. Patent No. 4,912,052, issued to Miyoshi et al. (hereinafter, Miyoshi). Applicants respectfully disagree with the Examiner. Miyoshi discloses a non-imaging device which is designed to induce a charge in the substrate not to reduce charging at a surface of the substrate as claimed in claim 9.

Miyoshi discloses at col. 3, line 50 through col. 4, line 51 a voltage induction mode, wherein the Miyoshi apparatus charges the surface. Miyoshi states that the "apparatus has two operation modes. First is a voltage induction mode for inducing a voltage on the target." *Miyoshi*, col. 3, lines 51-53 (emphasis added). As noted previously, Applicants' claimed invention is directed at reducing charging, and thus Miyoshi is inapposite to that which is intended by Applicants. [Applicants respectfully assert that Miyoshi was neither intended nor does it disclose a method for minimizing the charging on the substrate as claimed by Applicants.] Applicants respectfully request withdrawal of these rejections.

At page 6, item 8 of the Office Action, the Examiner rejected claims 42, 45-50, 53-55, and 59-61 as being anticipated by U.S. Patent No. 4,996,434, issued to Tanaka (hereinafter, Tanaka). As detailed below, Applicants respectfully disagree with the Examiner.

Claims 42 and 55

Claims 42 and 55 are amended herein to include the clarifying language that the detected electrons are non-reflected electrons, which includes secondary, backscatter, and transmission electrons. Applicants note that this amendment does not narrow the scope of either claim 42 or 55, but merely clarifies what previously had been claimed. Support for these amendments can be found throughout the specification. For example, col. 9, line 19 – col. 13, line 24, as well as Figures 4 and 5, disclose detector 160 (backscattered electron detector), detector 117 (secondary electron detector), and detector 129 (transmission electron detector). Claim 55 is also amended herein to present the claim in proper form. The phrases “method of” and “method comprising” are hereby replaced with “system for” and “system comprising” (respectively). Because these latter amendments correct the form of the claim, Applicants respectfully submit that the requirement to provide explanation of the support in the disclosure of the patent for the amendments, as specified in 37 CFR 173(c), is inapplicable.

Concerning the Examiner’s assertion that Tanaka anticipates both these claims, Applicants respectfully disagree. Tanaka discloses detecting only reflected electrons. For example, Tanaka discloses:

A reflected beam detector 39 is disposed as image detecting means at a location above the Y table 16, and is arranged to detect electrons reflected from the plate 5, thus outputting the obtained data to the calibration unit 90 which constitutes an picked-up image pattern data generating means.

(*Tanaka*, col. 5, lines 11-16) (emphasis added).

Because Tanaka fails to teach or suggest detecting non-reflected beams, it cannot properly anticipate claim 42 or 55. Applicants respectfully request withdrawal of the rejections of claims 42 and 55.

Claims 45-48

The Examiner also rejected claims 45-48 under 35 U.S.C. § 102(b) as being anticipated by Tanaka. Since each of these claims depends from claim 42, each contains all the limitations of claim 42. As discussed above, the cited reference neither discloses nor suggests the detection of non-reflected electrons as recited in claim 42. Thus, for at least this reason, claims 45-48 cannot be anticipated by Tanaka. Therefore, Applicants respectfully request withdrawal of the rejections of claims 45-48.

Claims 49 and 59

Claim 49 recites a method of automatically inspecting insulated surfaces of a substrate by controlling the build up of surface charge on the substrate. The method includes performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to control the charge density; performing repeated swaths for a pattern feature of the substrate so as that the resulting multiple feature images are exactly aligned and can be overlaid precisely; and averaging the multiple image features to maximize signal contrast in the image of the pattern feature. Claim 59 recites a method for inspecting insulating and thermally sensitive surfaces of a substrate. The method includes performing an electron beam inspection of the substrate in multiple swaths, an electron beam dose per swath being selected to control thermal load per swath; performing repeated swaths for a pattern region of the substrate so as that the resulting multiple region images are exactly aligned and can be overlaid precisely; and averaging the multiple region images to maximize signal contrast in the image of the substrate.

Both independent claims require averaging signals taken from multiple swaths in order to maximize signal contrast in the image.

The Examiner points to no portion of Tanaka in support of anticipation of either claimed method. Review of Tanaka reveals that Tanaka neither discloses nor suggests either method. Thus, Applicants respectfully request withdrawal of the rejections for claims 49 and 59.

Claims 50, 53, 54, 60, and 61

The Examiner also rejected claims 50, 53, 54, 60, and 61 as being anticipated by Tanaka. Claims 50, 53, and 54 depend from claim 49, and claims 60 and 61 depend from claim 59. Applicants respectfully request withdrawal of the rejection of these claims for at least the reasons stated above regarding claims 49 and 59.

Rejections Under 35 U.S.C. § 103(a)

At pages 6-10, item 9 of the Office Action, the Examiner rejected claims 23-25 under 35 U.S.C. § 103(a) as being unpatentable over Miyoshi in view of Tanaka. The Examiner also rejected claims 31-41, 43-44, 51, 52, and 56-58 under 35 U.S.C. § 103(a) as being unpatentable over Tanaka.

Claims 23-25

Claim 23 recites a method of inspecting a substrate. The method includes exposing a substrate to a first group of electrons, which causes the substrate to emit electrons; exposing the substrate to a second group of electrons, wherein the second group of electrons reduces charging at a surface of the substrate, which charging results from the emitted electrons; detecting the emitted electrons; and processing signals resulting from the detected electrons, wherein the signals are processed by comparison with a reference to detect defects present on the substrate.

As noted above with respect to claim 9, Miyoshi fails to disclose all the limitations of independent claim 9. Thus, neither Miyoshi nor Tanaka taken individually or in combination disclose or suggest all the elements of the claimed invention in claims 23-25 which depend from claim 9. For at least this reason, Applicants respectfully request withdrawal of the rejections of claims 23-25.

Claims 34, 37, and 40

Each of claims 34, 37, and 40 are amended to include the limitation wherein the processor further includes an image processor to compare images from two different locations on the substrate and determine the location of defects on the substrate when the comparison detects a difference. Support for these amendments is found, for example, at col. 6, lines 4-31 and Figure 3a.

Applicants note that claim 34 has been written in independent form to include the limitations of claim 31. Applicants note that such an amendment does not narrow the scope of claim 34. Applicants have also amended claims 33, 35, and 36 to include proper dependency from amended claim 34. Because these amendments are one of form, Applicants respectfully submit that the requirement to provide explanation of the support in the disclosure of the patent for this amendment, as specified in 37 CFR 173(c), is inapplicable.

Concerning the rejection of these claims, the Examiner acknowledged that Tanaka “discloses all the features as discussed above except ... means for comparing images from two different locations on the substrate.” *Office Action*, p. 8 (emphasis added). Applicants agree. However, citing col. 1, lines 46-49, the Examiner went on to state that this limitation is an obvious variation of Tanaka. Applicants respectfully disagree. Upon closer reading of the section cited by the Examiner, Tanaka teach away from die-to-die comparing. Tanaka states

such a die checking means has “a critical disadvantage.” *Tanaka*, col. 1, line 61. Because *Tanaka* actually teaches away from the die-to-die inspection, Applicants submit that *Tanaka* cannot create an obviousness rejection.

Applicants respectfully request withdrawal of the rejection of claims 34, 37, and 40. Applicants also respectfully request withdrawal of the rejections for each of the claims that depend from each of them (i.e., claims 33, 35, 36, 38, 39, and 41) for at least the reasons stated above regarding claims 49 and 59.

Claims 43 and 44

As noted above, Claim 42 is amended herein to include the clarifying language that the detected electrons are non-reflected electrons, which includes secondary, backscatter, and transmission electrons. Because *Tanaka* fails to teach or suggest detecting non-reflected beams, claims 43 and 44 cannot be obvious in view of *Tanaka*. Applicants respectfully request withdrawal of the rejections of claims 43 and 44.

Claims 51 and 52

As noted above with regards to claim 49, *Tanaka* neither teaches nor suggests averaging signals taken from multiple swaths in order to maximize signal contrast in the image. For at least this reason, claims 51 and 52 cannot be obvious in light of *Tanaka*. Applicants respectfully request withdrawal of the rejections of claims 51 and 52.

Summary

Claims 1-8 are allowable.

Claims 9-61 were rejected.

Claims 27, 28, 30, 33-37, 40, 42, and 55 are amended herein.

Claims 31, 32, and 56-58 are canceled herein.

New claim 62 is added herein.

Reconsideration of this application as amended, and allowance of all pending claims, as amended, are hereby respectfully requested.

Applicants believe that the application is in condition for allowance of all claims remaining herein, and therefore an early Notice of Allowance is respectfully requested. If the Examiner believes that for any reason direct contact with Applicants' attorney would help advance the prosecution of this case to finality, the Examiner is invited to telephone the undersigned at the number given below.

Respectfully submitted,

Date: March 18, 2002

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